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# Climate Variability Impacts on the Small-Scale Farmers and Their Adaptations in Humbo and Duguna Fango Woredas of Wolaita Zone

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**Abstract**
The challenge of climate change is becoming a global issue. In every corner of the world the people are worried about climate changes. The reason is it has an adverse effect generally to all people and particular to rural livelihoods. This study was conducted in Wolaita zone, southern Ethiopia, in selected Woredas, namely Humbo and Duguna Fango. The main objective of this study was to investigate the impacts of Climate change and variability on the livelihoods of small-scale farmers and their adaptations. The study used both probability and non-probability sampling methods to select informants. A total of 482 respondents were selected for this study by using probability sampling techniques. Since the sampled households were heterogeneous, stratified sampling technique was also used to represent male and female headed households in the study. The primary data was collected through semi-structured interview, field observation and key informant interview while Secondary data was collected from national meteorological Agency, published and unpublished materials. The data was analyzed by using SPSS and Excel software. The study revealed that local climatic conditions of these Woreda have been changed in the last three decades. Both meteorological data and the community response confirmed that rainfall is highly variable, while both minimum and maximum temperatures of the district are increasing. These variations are affecting the livelihoods of the small-scale farmers whose livelihoods dependent on agriculture (crop production and livestock production) by decreasing crop and livestock production. Small land size with large family size and the existing poverty are the major challenge for farmers to adapt climate change in the study area. The adaptations strategies that used by small scale farmers to climate change impacts are, the farmers involved in various off farm activities such as, seasonal migration and diversifying labor power, petty trading, borrowing from better-off farmers, resource sharing, renting their farm land temporarily, crop diversification, planting fast growing varieties, irrigation, sales of assets, getting loans through microfinance programs, saving. This study concludes that improving the health of livestock and farmers, reforestation, promoting water harvesting, small scale irrigation and land management techniques to retain soil moisture, diversifying household income, improving coverage and quality of climate data are all necessary in order to improve the livelihoods of local communities.
**Keywords**: Livelihood, climate variability, adaptation. Crop production, livestock.

## 1. Introduction

### 1.1. Background of the study

The challenge of climate change is becoming a global issue. In every corner of the world the people are worried about climate changes. The reason is it has an adverse effect generally to all people and particular to rural livelihoods. Climate change refers to any change in climate over time, whether due to natural variability or/and as a result of human activity (IPCC, 2007a). According to the fourth inter-governmental panel for climate change assessment report on climate change and variability, current scientific understanding reveal that the earth's climate is warming (IPCC, 2007a). The report highlighted that it is more likely now that emissions of heat trapping gasses (mainly CO2 and Methane) from anthropogenic activities are the major causes of climate change in our planet. Developing countries like Ethiopia are more vulnerable to adverse impact of climate change and variability. This is due to their dependence on rain fed agriculture, low level of economic development, limited disaster management skills, weak institutional capacity and low adaptive capacity (Helena Kahiluoto & Reimund Rötte, 2009).The climate of Ethiopia is varying from humid to semi-arid with abundant and scarce soil and air

 

moisture. In addition to this, extreme variations in rainfall occur from season to season and year to year. This inter-seasonal and inter-annual rainfall variability imposes impact food security, water and energy supply, poverty reduction and sustainable development efforts, as well as by causing natural resource degradation and natural disasters (Gebru and Abebe, 2010). The agriculture sector of Ethiopia is mainly done by smallholder farmers who are highly vulnerable to the impact of climate change as a result of poverty, marginalization and reliance on natural resource. Climate change in Ethiopia will likely bring increases in temperatures and uncertainty to rainfall patterns. The effects of rainfall in rural Ethiopia are already reporting (Regassa et al. 2010) IPPC defines adaptation as "Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities". A more familiar definition is: "Adaptation is about reducing the risks posed by climate change to people's lives and livelihoods" Climate change adaptation based on smallholder farmers offers an opportunity to address climate- related risks which have severe constraints on production in the agriculture sector. Adaptation should enable agricultural systems to be more resilient to the consequences of climate change (Alemneh, 2011). In Ethiopia, the number of work is done to reduce climate change and variability in different region of the country. But this effort is not enough to smallholder farmers to have the appropriate method of adaptation strategy. The same is true for Wolaita district.

### 1.2. Objectives of the study

#### 1.2.1. General objective

To investigate the impact of climate change and variability on smallholder farmers and their adaptation capacity in Wolaita Zone.

#### 1.2.2. Specific objectives

The specific objectives of the study are:

- To describe the climate change over time in the study area particularly rainfall and temperature.
- To assess the impact of climate change on smallholders agricultural practices.
- To examine the smallholders adaptation measures to the impact of climate change.
- To identify Adaptation Challenges to small holder farmers in study area.

### 1.3. Significance of the study

This study is significant because it will raise awareness among local communities about climate change and it will provide valuable information to share with other communities including local government bodies on the mechanism that enable local communities to adapt climate change impacts.

## 2. Materials and methods

### 2.1. Description of the study Area

This study was conducted in Humbo and Duguna Fango Woreda of Wolaita Zone which are found in the Southern National Nationalities and People regional State. Wolaita zone, has a total land area of 4537.5 Km2, is located between $6^0$4N to $7^0$1N and $37^0$4E to$38^0$2E and it is inhabited by Wolaitato speaking people or Wolaita people. Wolaita is bordered on the South by Gamo Gofa, on the West by the Omo River which separates it from Dawro, on the Northwest by Kembata Tembaro, on the North by Hadiya, on the Northeast by the Oromia Region, on the East by the Bilate River which separates it from Sidama, and on the South east by the Lake Abaya which separates it from Oromia Region. The administrative center is Sodo.

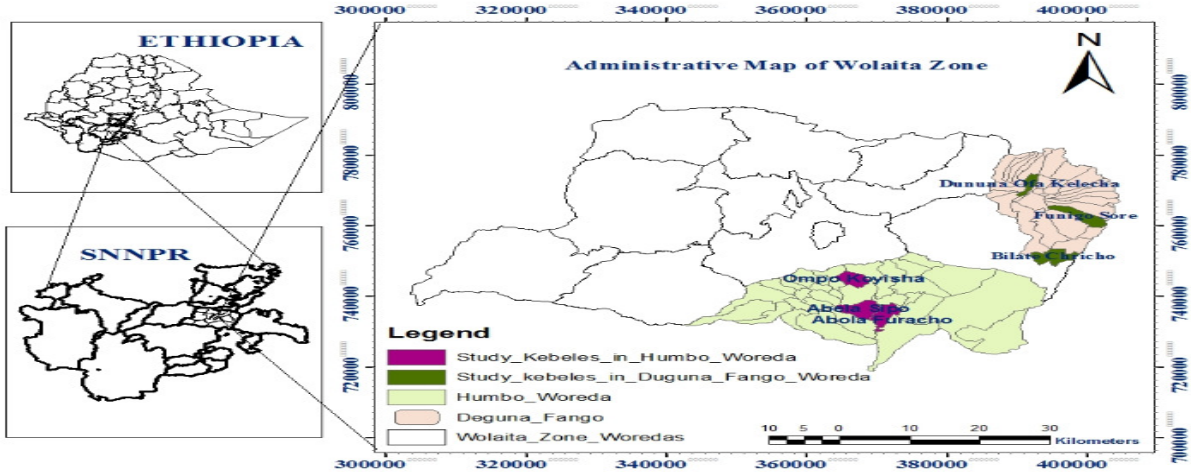


Fig. 1 Map of the study area.

### 2.2. Research Design

A mixed research approach, based on quantitative and qualitative methods, was used in this study. In order to get reliable data, survey was conducted on sampled households. Furthermore, purposively selected knowledgeable individuals (Key informants) were selected and interviewed

### 2.3. Sample and Sampling techniques

The study was conducted in Wolaita zone, which comprises 12 Woredas and three-town administrations. Of these, two Woredas namely Humbo and Duguna Fango were selected for this study using non-probability sampling techniques. The rationale behind the selection of these two Woredas was their different micro climatic conditions that would help to compare the effects of climate change in different micro climatic zones. From each Woreda three representative Kebeles were selected namely Ampo Koysha, Abala Sipa and Abala Faracho from Humbo Woreda, Fango Sore, Duguna Ofa Kalacha and Bilate Charicho from Duguna Fango Woreda were selected using non-probability sampling techniques by considering the different agro-ecology of these Woredas.

The target population for the study comprised households living in these selected Kebeles.. From each kebele, households were selected by using random sampling techniques from kebele administration registration lists depending on their population size by applying the formula suggested by (Yamen 1967).

The stratified random sampling design was also adopted for this study. The strata of the sample are based on male and female-headed household, and on the agro-ecology (Kebele) of the Woredas.

$$n = \frac{N}{1 + N(e^2)}$$

Where n= the desired sample size
N= Population size
e= level of precious (±10%)

Based on this formula the sample size of the study was **482** households

### 2.4. Data Source and data collections

In this study, both primary and secondary data were used. The primary collected through household survey questionnaires and interviews with key informants and experts of the area. The secondary data (meteorological data) was collected from the National Meteorological Agency. The missing values for Meteorological data (rainfall and temperature) obtained by the polynomial interpolation of order. The other secondary data collected from reports, policy documents, published and unpublished sources. The coefficient variation for inter annual and intra annual rainfall variability can calculate by using the formula suggested by UNESCO (2005)

### 2.5. Method of Data Analysis

The raw data collected from primary sources through household interviews were subsequently edited and computed manually and entered into SPSS version 20 software and analyzed for regression and frequency by this software. The result of primary data was presented in tables and charts. On the other hand, the secondary data used for this study obtained from the National Meteorological Agency were entered into Microsoft excel software and were analyzed by using this software. Similarly, qualitative data from key informants and experts was interpreted, analyzed and synthesized. The coefficient variation for inter annual and intra annual rainfall variability can calculate by using the formula suggested by UNESCO (2005).

$$CV_X = \frac{\sigma_X}{\mu_X}$$

Where:
CVx= Coefficient Variation for x month/ year, σx= Standard deviation of x month/ year and μx= mean value of x month/ year.
NMA classified rainfall variability bases on the value of CV as < 20 % as low, from 20-30 % as moderate and > 30% as high (Lema Gonfa, 1996)

## 3. Result and Discussions

### 3.1. Socio-economic and demographic characteristics of the respondents

The socio-economic and demographic variables/attributes that were identified in this study-included gender, marital status, age, educational status, family size, type of occupation, size of the land holding, net monthly income, and livelihood assets of the sampled households. The rationale behind the identification of these attributes was the likely effects (which can be either positive or negative) of most of these factors in determining an individual‘s or household‘s livelihoods and an entire community‘s coping mechanisms of adaptation to climate change. It is also important because the adaptive capacity of communities is determined by their socioeconomic characteristics.

 

Regarding educational status, majority of the respondents have low educational status. About 50% of total respondents in Duguna Fango (Fango Sore) and 30% (Abala Sipa and Abala Faracho) of the respondents in Humbo Woreda were unable to read and Write. About 30% of respondents in Abala Sipa (Humbo), above 20% in Bilate Charicho, Duguna Offa Kalacha (Duguna Fango) were attended from grade 1 to 4. Low educational status has its own implication in adaptation to climate change impacts. Various studies suggest educational status determines an individual's or a group's environmental awareness, knowledge, attitude, and skill to adapt or improve their future chances. Moreover, education also indicates the potential for exchange of information between various stakeholders and communities as written materials.

### 3.2. Livelihood Strategy of Smallholder farmers

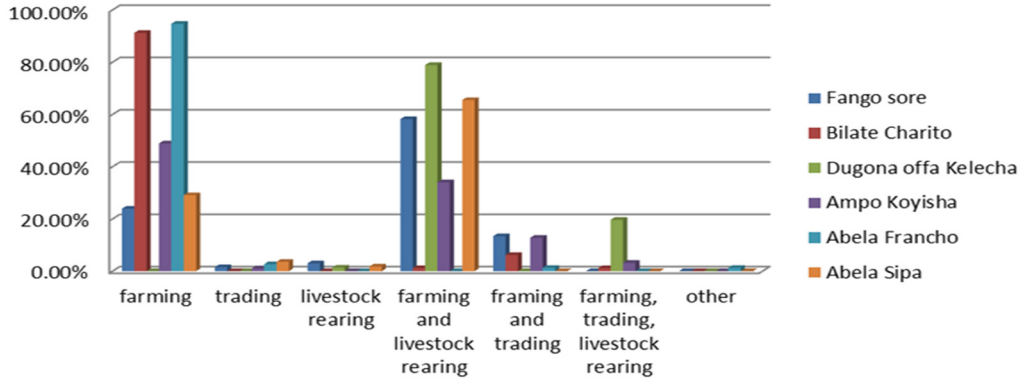


Fig. 2. Livelihood Strategy of Smallholder farmers

Majority of small scale farmers in study site engaged in farming, 85% in Duguna Fango and 60% in Humbo (Crop production and livestock production). This highly dependency in climate sensitive livelihood strategies greatly affects small scale farmers in small change in climate system. Small change in Temperature and rainfall adversely affect their livelihoods.

### 3.3 Meteorological Data Analysis

#### 3.3.1 Overall Rainfall Variability, Trends and Analysis

Rainfall data from National Meteorological Agency show that the rainfall pattern of the study area is extremely variable. The following fig. 3 & 4 show the distribution of annual rainfall and main trends.

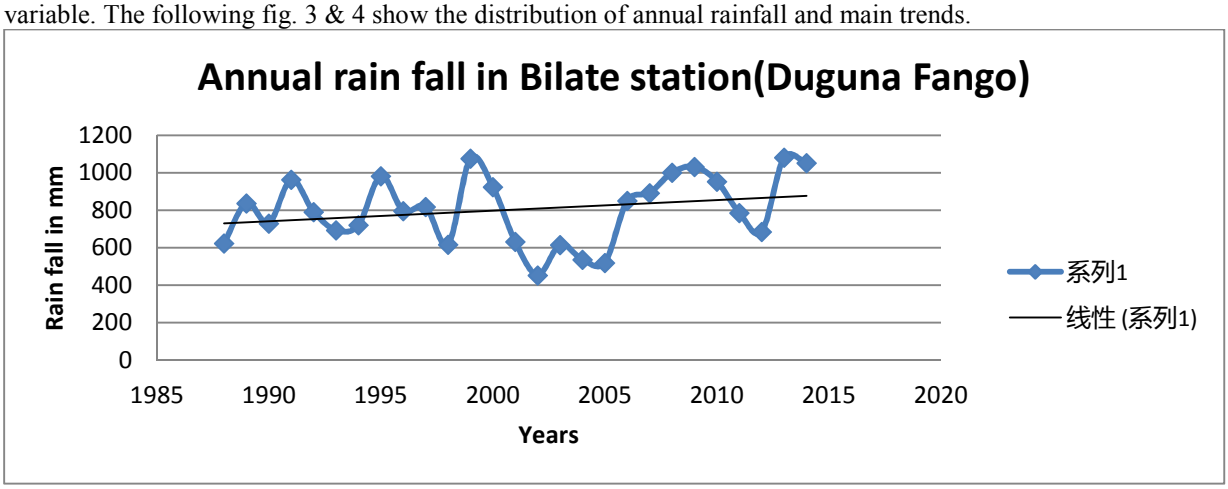


Fig. 3 Average annual rainfall in Bilate station

 

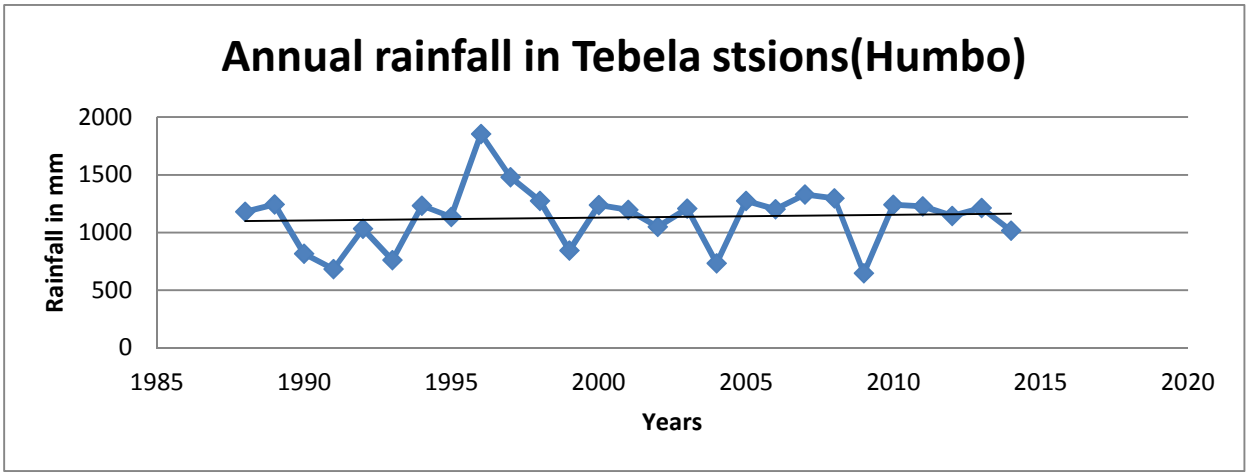


Fig.4 annual rainfall in Tebela stations

As indicated in above figure the rainfall pattern for the two stations generally characterized by a high degree of inter-annual variability and the total rainfall is progressively decreasing over the lowland Wolaita (Humbo) and slightly increasing (Bilate station) in the last two decades.

This is in agreeing with NMA, 2007; the average annual rainfall trends in the past four or five decades show decreasing trends in the Sothern lowlands. The amount of rainfall and crop production is strongly related. As rainfall is adequate, annual production of the area also sufficient. In addition to meteorological data, field household survey response from rural farmers verifies this notion of less rain. In terms of rainfall almost more than 50%, 40% and less than 10% in Humbo and Duguna Fango district, answered as the rainfall not start on time, start on time but low in amount and start on time but high in amount respectively. The respondents in each Kebeles agreed that there is a change in rainfall amount and pattern in their areas. This may be one of the sign that there is climate elements variability in the study area. The change in rainfall in the local area can be expressed by decreasing or increasing rainfall and changing the rain seasons of the areas. Historical record of rainfall also reveals this fact in Humbo Woreda in 1991, 1993, 2005 and 2009. Besides its quantity, the time of rain falling was difficult to predict in recent years. Irregularity in arrival of the first rains inadequacy in the amount received, and failure of the rainfall in the middle of the growing season are said to be the main seasons for climate variability in Wolaita (Ayele Tessema, 2008). With this respect, the smallholder farmers were asked how the changes in rainfall in their area are exhibited and their responses are presented on the fig below.

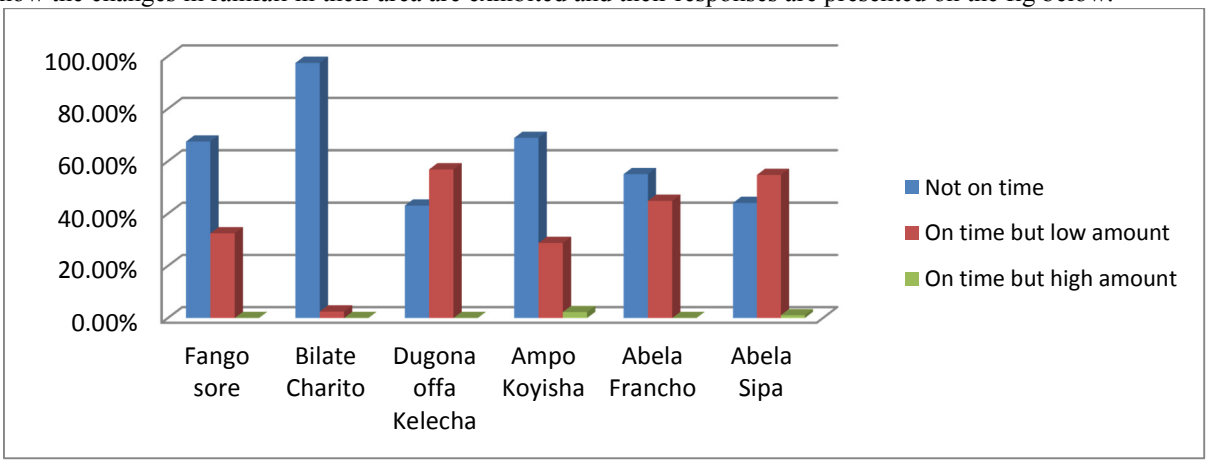


Fig.5 rainfall variability response in study site.

### 3.3.2 Seasonal Rainfall Patterns

The livelihoods of the study area are highly dependent on rein-fed agriculture (crop and livestock production), which is in turn dependent on the availability of seasonal rainfall. Keremt is the main production season in the study area and the amount of rainfall in keremt determines the productivity and crop yield of farmers. Belg rain is also equally important for preparation of the land for the next production season and Belg crop production. Both Belg and Keremt are the main production season in Wolaita. The rainfall patterns in both production seasons determine the crop yield and productivity of the district. The calculated coefficient variation for the two stations for annual and seasonal rainfall variability indicates that there is high inter annual and intra annual rainfall variability in study area.

 

Table 1. Annual and seasonal rainfall (in mm), coefficient of variation in Bilate and Humbo Tebela stations.

| Stations | Annual | | Belg(March, April, May) | | Kermit(June, July, August) | |
|---|---|---|---|---|---|---|
| Bilate | Mean | CV | Mean | CV | Mean | CV |
| | 813.3 | 0.22(22%) | 91.6 | 0.35(35%) | 83.1 | 0.37(37%) |
| Tebela | 1130.8 | 0.23(23%) | 116.4 | 0.38(38%) | 149.2 | 0.37(37%) |

Table 2. Intra annual rainfall variability in Bilate, Humbo Tebela and Wolaita Sodo stations

| Stations | Belg rainy season | | | | | | Kermit rainy season | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | March | | April | | may | | June | | July | | August | |
| | Mean | CV | Mean | CV | Mean | CV | Mean | CV | Mean | CV | Mean | CV |
| Bilate | 57.5 | 69% | 119.3 | 26% | 97.9 | 49% | 75.2 | 64% | 95 | 63% | 79 | 45% |
| Humbo Tebela) | 67.2 | 56% | 138. | 46% | 150 | 50% | 129.2 | 50% | 161.7 | 40% | 156.8 | 48% |

Inter-annual rainfall variability as measured by the coefficient of variation of annual rainfall totals in three stations indicates that there is moderate inter annual variability in both Bilate (22%) and Humbo Tebela station (23%).. In terms of seasonal variability of rainfall, there is high seasonal variability in all stations in both Kermit and Belg seasons. Monthly rainfall variability is very high in all stations for all months. The month March in all stations, lead the highest rainfall variability (69%, 56%) for Bilate and Humbo Tebela station respectively. When compare July for all stations, in Bilate station it is very high (63%) than Humbo (40%). As indicated in the above discussion March and July are very important months in Agricultural point of view. Rainfall in these months determines the annual yields in the study area. This variability has their own implications in crop production. Rainfall variability was the principal vulnerability factor, both in the lowlands and the highlands of Wolaita together with an apparent lack of public investment in infrastructure to reduce the risk of rain fed agriculture (Ayele Tessema, 2008). Studies also suggest that areas with high inter annual and intra annual rainfall variability can be expected to lag their economic development where the economy is based on rain-fed agriculture like in rural Wolaita (Lall and Brown, 2006). According to the authors, the intra annual rainfall variability present a significant challenge to early agriculture and the interaction between inter annual variability and spatial variability affect the agriculture as extended drought can affect economic activity and rural livelihoods (Lall and Brown, 2006). The research conducted in Wolaita by Ayele Tessema in 2008 also indicates that, rainfall variability in rural Wolaita was by far the key source of risk and vulnerability. In the lowlands (Humbo), the rainfall regime was characterized by frequent failures, inadequate amounts, and poor distribution over the growing seasons. Even though the highlands received relatively higher rainfall, irregularity of occurrence, poor distribution over the growing seasons and frequent downpours were key problems (Ayele Tessema, 2008).

**3.3.3 Temperature Trends of the study area**

Temperature is the quantity that tells us how hot or cold something is relative to some set standard values. The degree and intensity of temperature determines the rate of evapotranspiration, soil moisture content and the humidity of the atmosphere. Temperature of a particular area also determines the agricultural productivity (crop and livestock).

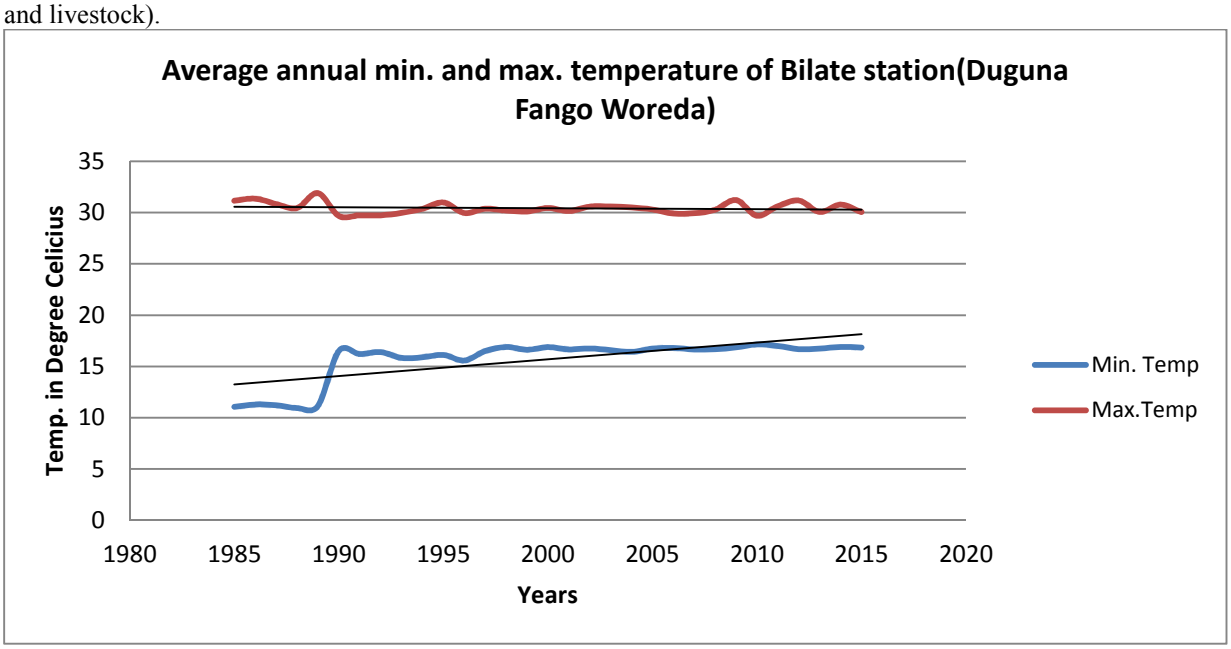


Fig.1. Average Annual Minimum and Maximum .Temp in degree Celsius for Bilate station

 

The above figure shows that there is an increment for the 30 years trend of both annual maximum and minimum temperatures recorded at Bilate station. Although for Humbo station the temperature data was not available, it is assumed that the pattern is similar to the Bilate station. Thus, temperature records are also an indication of local climate change towards warmer climates.

Household survey responses obtained from rural informants revealed that farmers thought the temperature of the area has been increasing with time. This belief of local community has been corroborated with data records. Accordingly, 78% of total respondents in Humbo and 72% of respondents in Duguna Fango District said temperature was increasing gradually. It is undeniable that small increases in temperature can also result in measurable impacts on the livelihoods of local communities by reducing crop and livestock productivity. According to some informants, the increasing temperature makes the situation in the area unfavorable for indigenous crop varieties, and the yield of these varieties has been decreasing for the last 10 or 15 years. Thus, the farmers have been forced to use improved crop varieties (new coming varieties) in order to cope with the situation. Due to this, the indigenous crop varieties are gradually being decreasing from the area. This leads to the loss of biodiversity. In climate sensitive tropical areas, a small rise in temperature can severely disturb natural conditions with adverse effect for water availability and crop productivity (UNDP 2011).

### 3.4. Impacts of Climate Changes

#### 3.4.1. Impacts on Crop productions

Climate variations have serious impacts on crop production. Since much of household consumption derives from crop production in Wolaita zone, losses of productivity in crop production impose serious impacts on family food security and can lead to malnutrition. During a prolonged dry season and if there is a delay in the onset rain, the land becomes dry and difficult to plough. Particularly, Belg rain delays determine the productivity of the area. Late onset of rain affects crop productivity by shifting the crop-growing season. The household survey result revealed that 57% in Humbo and 49% in Duguna Fango District, the crop production decreasing due to climate related hazards, although the government effort to increase crop productions. Variability in rainfall and temperature patterns has significant impacts on the net revenue of the farmers. According to Temesgen and Rashid (2009), general increasing annual temperature reducing the revenue per hectare by US$ 21. In addition to temperature, Temesgen and Reshad (2009) describe that rainfall variability also affects the net revenue of rural farmers in Ethiopia

#### 3.4.2. Impact on Livestock productions

Livestock production is the main livelihood or income generating activity in Wolaita following crop production. There is a high potential of livestock production in Wolaita particularly in Humbo district. Climate variation can have negative impacts on the productivity of livestock by affecting their health, causing shortage of fodder and grass, reducing water availability particularly during extended drought and deficiency of rain.

About more than half (61%) of the respondents answered that Climate changes cause shortage of grass and water, diseases and deaths of livestock. For example in the year 2008/2009, the highest deaths of cattle, sheep and goats were experienced according to interviewed farmers. The CSA 2008/2009 confirmed the idea of a higher number of livestock deaths related to other than natural causes i.e. mainly related to weather and climate in 2008-2009. In 2016/2017 the El-Nino induced drought in Humbo district resulted in death of many livestock's.

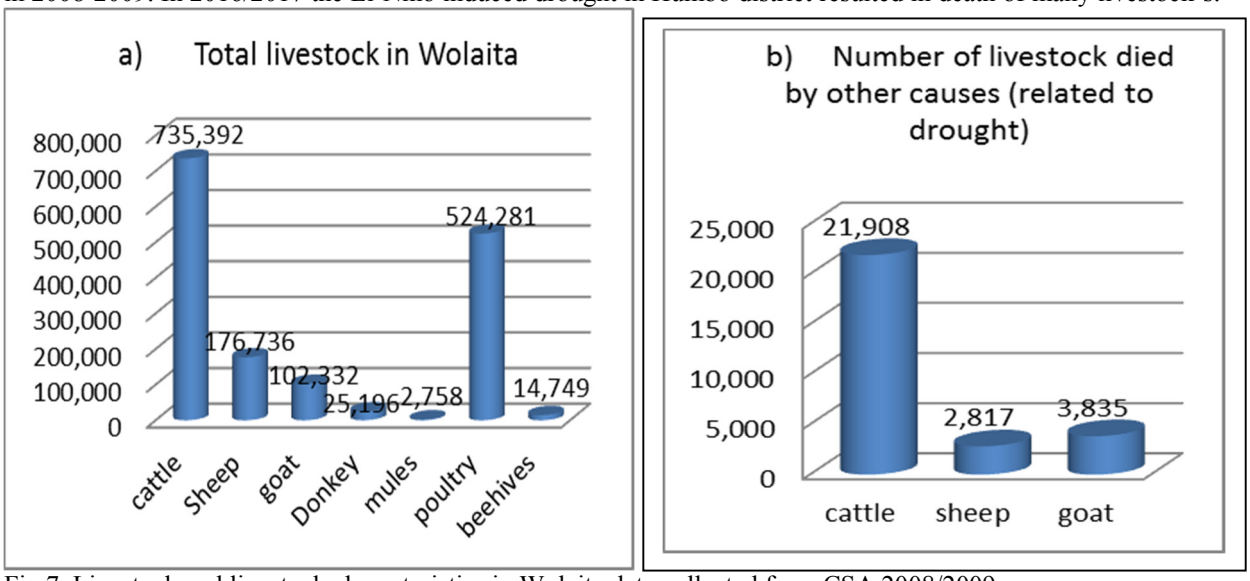


Fig 7. Livestock and livestock characteristics in Wolaita data collected from CSA 2008/2009

 

### 3.4.3. Impacts of climate change on biodiversity

Climate change directly affects biodiversity of developing countries like Ethiopia. There are facts that climate change is already affecting biodiversity and will continue to do so. According to the United Nations millennium ecosystem assessment, 2006 climate change ranked among the direct drivers affecting ecosystem. The assessment reports indicates that the consequences of climate related change on the species component of biodiversity include change in distribution, increasing extinction rate, changes in reproduction timing and changes in length of growing season for plants. The respondents in the study area (45%), saying that climate change affects biodiversity in two main ways. The first one is by deforestation that is during drought periods and crop production failure; small households cope with this situation by selling the large and indigenous plant species that are used for timber production and fuel wood. This leads to removal of larger trees in the area that contribute more for soil moisture retention such as Wanza (Cordia africanca), Shola (Ficus vista), Dokima (Syzigium guineense), Zigba (Afrocarpus falcatus), Ficus species and others. The second way that the climate change is affecting biodiversity in study area, the indigenous crop varieties, which are adapted to the very specific climate of the area, are now their productivity decreasing and are being lost gradually because small changes in climate are affecting crop productivity.

### 3.5. Local Community Perception about Climate Change

Individual household survey responses in the study area indicated that resident of Wolaita zone feel that the local climate has been changing in the last decade. About 93% of the total respondents confirmed that the local climate changing in their district in the period under discussion. They mentioned the indicators of local climate change as, by comparing the current existing situation with the situation twenty years ago. They said that now a day's everything in our environment is changing; shortage of rainfall, seasonal shifting of harvesting period, frequently occurring drought. They also feel that the climate change is real and we are living with uncertain climatic conditions. According to one of the elders Ato Jorge Herano (75 years old) in Boloso Sore Woreda,"except maleness and femaleness, and day and nights, everything in our surrounding environment including climate seems to have been changing. Temperature and drought increasing, rainfall pattern has changed over time, drought occurs frequently, crop production is decreasing, food insecurity is high in the area, soil moisture is decreasing, domestic animal deaths are increasing, and water resources are decreasing in number due to drying of rivers and springs. Twenty years ago, the Belg rain started in January and preparation of land for Belg production season and cultivation started in January but now this is completely changed and Belg rain has shifted to April, and it is inadequate and stops earlier than the usual " he said". Due to this seasonal change and prolonged drought season, we lose indigenous plants such as inset or false banana (Inset ventricosum) varieties, maize (Zea mays) varieties, sweet potato and others".

### 3.6. Small holders Adaptation to Climate Change impacts

Adaptation refers to adjustments in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts. It refers to changes in processes, practices, and structures to moderate potential damages or to benefit from opportunities associated with climate change. Some of adaptations strategies of small holders in study area were:

#### 3.6.1. Labor Power

About 73% of respondents in Humbo and 78% of respondents in Duguna Fango said that during climate shock such as drought and shortage of rainfall (dry season) which are not favorable to agricultural production, many family members migrate to other places and are engaged in different manual labor work such as construction or serving other better-off farmers to generate income and to feed their family. Most of the time, the husbands and youngsters migrates during the period of shortage of food in the household to try to earn a living elsewhere. In addition, labor is diversified to make goods like injera, local cultural drinks to sell and make money.

#### 3.6.2. Sale of Assets

Livelihood asset particularly livestock helps the rural community of Wolaita to cope with prevailing local environmental problem depending on their property (asset) ownership. Livestock and forests are the main asset of local communities in Wolaita after crops. Most of the time livestock is preserved for adverse conditions that the communities could face such as a climate crisis. By selling livestock and their products such as milk, butter, cheese and others, communities can get money and buy food and other materials that are necessary for their survival. Eucalyptus tree most commonly planted serves as an income source by cutting down and selling during time of livelihood crisis. About three fourth (76%) of respondents said that the above-mentioned coping mechanism used during unfavorable conditions in their area.

#### 3.6.3. Borrow from Better-off Farmers

Borrowing from better off farmers is common practice as a coping mechanism during climate shocks in Wolaita. In most cases, the households borrow money from moneylenders. About more than 45% of respondents answered that this is adaptation mechanism for them. The borrowing may be an exchange of money in the form

 

of borrowing/ lending money, or by exchanging resources in the form of crops (maize, wheat or others), livestock and paying back to the better-off farmers with profits or without profits after the shock when the conditions are favorable.

**3.6.4. Petty Trading**

During climate shocks rural women participate in petty trading such as selling of fire wood, 'injera', local drinks such as *Areke and Borde* (local drinks used by local people) and others and earn money from trading these items to support their family's needs they said this as one coping mechanisms.

**3.6.5. Planting Fast-Growing Varieties**

In recent years, farmers shifted towards fast growing and improved seed varieties that are best adapting and withstand the current climatic conditions in Wolaita. Seeds such as maize, wheat and other crop varieties such as potatoes and cassava.

### 3.7. Local Communities Constraints to Cope with Climate Change

During household survey data collection, respondents identified their major constraints affecting coping and adaptation to climate change. Responses included 45%, 39%, 33% 23%, 17% and 9% of respondents saying that rapid population growth, uncertainty of rainfall patterns, loss of soil fertility and moisture, small land size with large family size, lack awareness to climate change and lack of capital respectively were the main constraints to cope with climate variability. Recent research findings indicate that there are some constraints to adaptations to climate change for rural communities. For example Adger, *et al*, (2007) indicates that the distribution of adaptive capacity within and across societies correspond to a major challenge for development and a major constraint to the effectiveness of any adaptation strategy. Limited rural finance is the main constraint identified by this group.

## 4. Conclusions

Based on the analysis of the data obtained from various sources for this research and the discussion throughout this study, the following major conclusions can be made.

- Socio-economic and demographic data result shows that, generally, the big family size compounded with very small land holdings and very low monthly income indicate food insecurity and challenge for adaptation to Climate Change in study area.
- There are indicators suggesting that of local climate is changing in Wolaita district/Zone. Meteorological data for rainfall and temperature recorded in Humbo and Duguna Fango Woredas (Tebela and Bilate stations) show trends towards hotter temperature and highly variable rainfall pattern than in the past.
- Climate change and variation together with other factors such as rapid population growth, land degradation, invasion of exotic plant species (Eucalyptus tree), can increase the frequency and severity of drought, death of livestock, decline in crop yields, and food and water shortages for both human and animals.
- These risks are more intense in the lowlands of Wolaita (Humbo Woreda) than and highlands, pose big risk for most households. The cumulative effect of these risks can lead to the community's livelihoods loss and make the situation difficult in building household assets and it will be continued in the future as the business continue as usual.
- The major traditional adaptation mechanisms of rural small hold farmers for climate change and variability impacts are manual labor work diversification, seasonal migration to other places to find additional income, borrow from better off farmers, renting their land for a number of years as exchange for money or food, sale of assets particularly livestock and trees, resource sharing, diversification of crops, shifting towards improved seed varieties, and cultivation season shift.

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